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PENSOFT

First record of Tweedy's Crab-eating Rat, *Ichthyomys tweedii* Anthony, 1921 (Rodentia, Cricetidae, Sigmodontinae), for Costa Rica

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Abstract
Tweedy's Crab-eating Rat, *Ichthyomys tweedii* Anthony, 1921, was described based on just a few specimens, and many aspects of its biology remains unclear. The species has only been previously reported to occur in two geographically disjunct areas in Panama and Ecuador. We report a new record of this species for southern Costa Rica. Our new record is the first for this species and the genus for Costa Rica, as well as the northernmost expression of the genus.

Keywords
Costa Rica mammals, Ichthyomyini, Las Cruces Biological Station, new record, range extension, water rat.

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Introduction

Neotropical, mostly semiaquatic sigmodontine mice and rats are grouped in the tribe Ichthyomyini Cockerell & Printz in Cockerell et al. 1914. This clade harbors 19 species in five genera, distributed in the Neotropics, mainly in South America (Pardiñas et al. 2017; Fernández de Córdova et al. 2019). The genus *Rheomys* Thomas, 1906 is the only ichthyomyine that is endemic to the Mesoamerican region, with four species distributed from Oaxaca in southern Mexico to western Panama (Voss 1988, 2015). In addition to these species, one species of the genus *Ichthyomys* Thomas, 1893 (*I. tweedii* Anthony, 1921) has been recorded in Panama, representing the northern distribution limit for the genus (McPherson 1985; Méndez 1993).

Tweedy's Crab-eating Rat, *Ichthyomys tweedii* Anthony, 1921, was reported from two localities in central Panama and eight localities in western Ecuador (Santillán and Segovia 2013). Its distribution ranges north to south from the mouth of the river Trinidad, Capira, in Panama (03°02′S, 079°41′W) to the type locality in Río Amarillo, Portovelo, Provincia del Oro, Ecuador (03°43′S, 079°39′W), and it occurs from sea level to elevations up to 1350 m (Voss 2015).

Many aspects of the natural history of this species remain unknown, for which it has been classified as Data Deficient on the IUCN Red List (Boada et al. 2019). This rare species has been reported to feed on fish, crabs, and aquatic insects in small streams surrounded by dense secondary vegetation (Voss 2015). Because ichthyomyine species are seldom captured and the reported geographical areas of occurrence for this species are far apart, it has been suggested to be more widely distributed (Voss 2015; Pardiñas et al. 2017).

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Here, we report the first find of *Ichthyomys tweedii* in Costa Rica. This report extends its known distribution range and adds a new species and a new genus of rodent to the list of mammals of Costa Rica.

Methods

A Tweedy's Crab-eating Rat was captured in Quebrada Wilson, a stream, at Las Cruces Biological Station in San Vito (Figs 1, 2). The rat was trapped accidentally using a minnow trap during a survey of freshwater amphibious crabs. The trap was baited with a mixture of canned sardines, wet, canned cat food and bread bundled inside a nylon stocking. The trap and bait were mostly submerged under water and left overnight. The rat was found dead underwater inside of one of the traps. The specimen was collected and a preserved skin, skull, and skeleton was deposited in the Museo Nacional de Costa Rica (MNCR), San José, Costa Rica.

In 2008, Quebrada Wilson was a small stream (1.5 m wide) consisting of small riffles, few rocks, abundant leaf debris, more pools than runs and a high canopy coverage (Davis and Brasher 2008). Relative to three other streams in the area, Quebrada Wilson exhibited the slowest water flow, the shallowest pools (ca 0.3 m in depth) and the greatest amount of woody debris and sandy substrate. In addition, Quebrada Wilson was recorded as the stream with the highest density of crabs (family Pseudothelphusidae) compared to the other nearby streams studied over 5–6 days of sampling (Davis and Brasher 2008; Delgai and Brasher 2008). The crabs in Quebrada Wilson were more abundant but smaller compared to the crabs found in the other three streams (Davis and Brasher 2008). The high density of small crabs, presumably juveniles, could be attributed to the microhabitat conditions found at Quebrada Wilson and suggested that streams with these characteristics could serve as a nursery habitat for crabs (Davis and Brasher 2008; Delgai and Brasher 2008). These microhabitat conditions may also be indicative of an optimal preying site for *I. tweedii*.

Three weeks after capturing the rat, we set Sherman traps (5.08 × 6.35 × 16.51 cm) by Quebrada Wilson (20 traps), Quebrada Culebra (20 traps), and Quebrada Culvert (15 traps) for 2–3 nights. Traps were baited with a mixture of tuna juice and cat food and were set near to the water edge of the stream and secured by a string attached to a nearby tree. However, the trapping was unsuccessful in capturing any rodents.

Results

New record. COSTA RICA • 1 ♀, adult with toothwear class 5 and fused sphenoccipital suture (following Voss 1988: 272); Puntarenas Province, Coto Brus Canton,

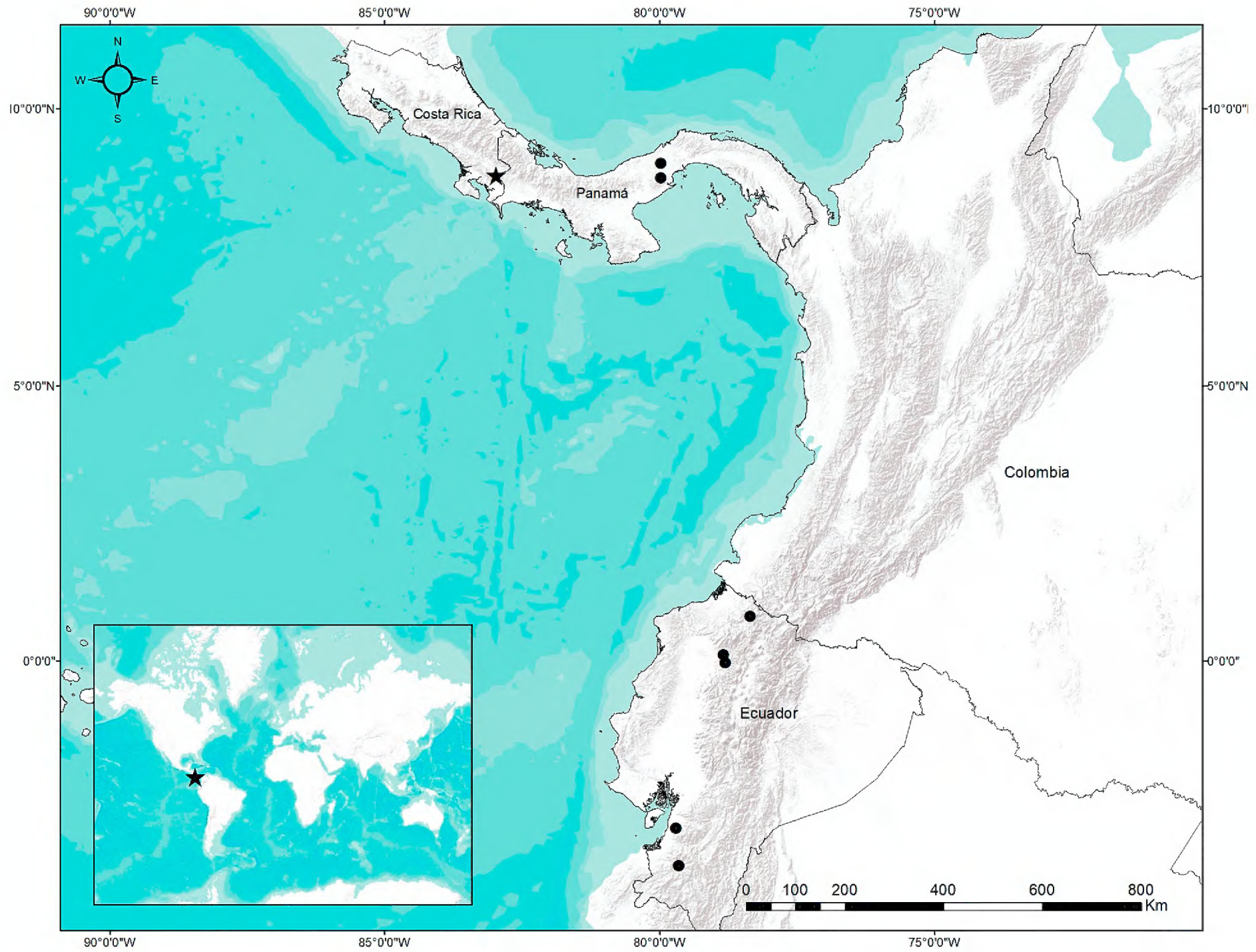

Figure 1. Map showing reported localities for Tweedy's Crab-eating Rat, *Ichthyomys tweedii*. Black star, new record: Las Cruces Biological Station, San Vito, Puntarenas Province, Costa Rica (08°47'05.60"N, 082°57'51.01"W, datum WGS84).

Figure 2. Capture site of *Ichthyomys tweedii* at Quebrada Wilson, Las Cruces Biological Station, San Vito, Puntarenas Province, Costa Rica. See methods for detailed description of the physical characteristics of the stream at the time of capture in 2008.

San Vito district, Las Cruces Biological Station, Quebrada Wilson; GPS data at trap site: 08°47′05.60″N, 082°57′51.01″W (Fig. 1); 1177 m a.s.l.; 1 July 2008; Anne Brasher, William Davis II, and Stephanie Delgai collectors; MNCR-M2106.

The specimen represents the first adult female collected in the Costa Rica-Panama area.

Identification. The specimen was identified as *Ichthyomys tweedii* following Voss (1988, 2015). The identification was made on the basis of external morphological, cranial, and dental traits and measurements (Table 1; Figs 3, 4). The revised specimen was identified as member of the genus *Ichthyomys* based on the observation of the next set of traits: absence of superciliary vibrissae, small but visible ears, manus with five plantar pads, large body size (>100 g), supraorbital foramina opening dorsally on surface of frontal bones, occipital condyles well developed and visible on dorsal view, shape of cutting edge of superior incisors as deep inverted "v", and presence of gnathic process. In addition, the cranial and dental dimensions fall within the range of variation reported for the four Panamanian specimens collected in the 1970s (R.S. Voss pers. comm.; Table 1).

Among the five currently recognized species of *Ichthyomys* (Pardiñas et al. 2017; Fernández de Córdova et al. 2019), the reported Costa Rican specimen was

Table 1. External, cranial, and dental measurements in mm of Tweedy's Crab-eating Rat *Ichthyomys tweedii* (MNCR-M2106) collected in Quebrada Wilson, Las Cruces Biological Station, San Vito, Puntarenas Province, Costa Rica, and comparison to the previously reported specimens collected in Panama. Measurements were taken following Voss (1988: 269–271). MNCR (Museo Nacional de Costa Rica), LACM (Natural History Museum of Los Angeles County), USNM (National Museum of Natural History, Smithsonian Institution).

Variables	MNCR-M2106	LACM 43464	USNM 461078	USNM 460684	USNM 461094
Year	2008	—	1971	1970	1972
Locality	San Vito, Costa Rica	Río Trinidad, Panama	Capira, Panama	Capira, Panama	Capira, Panama
Age	5/f/a	5/f/a	4/f/a	4/f/a	4/f/a
Sex	female	male	male	male	male
Tail length	322	—	292	275	361
Length of head and body	165	—	144	143	197
Length of tail	157	—	148	132	164
Length of hind foot	36	39	38	36	40
Length of ear	9	—	12	10	11
Weight (g)	125	—	123	127	155
Condylo-incisive length	34.2	34.7	34.7	33.8	37.5
Length of diastema	8.9	9.6	9.6	9.6	10.7
Length of maxillary molars	4.7	4.4	4.7	4.5	4.6
Length of incisive foramina	6.3	7.1	7.2	7.0	7.8
Breadth of incisor tips	3.1	2.2	2.4	2.4	2.6
Breadth of incisive foramina	1.9	2.5	2.2	2.3	2.3
Breadth of palatal bridge	3.3	3.5	3.3	3.4	3.5
Length of nasals	11.6	12.4	11.9	12.0	13.8
Breadth of nasals	3.5	4.3	3.8	4.1	4.4
Least interorbital breadth	4.9	4.6	4.7	4.8	4.8
Zygomatic breadth	16.9	18.3	17.3	16.5	19.1
Breadth of braincase	14.3	14.6	14.3	14.9	14.9
Breadth of zygomatic plate	1.5	1.7	1.4	1.4	1.8
Breadth of M1	1.5	1.5	1.6	1.6	1.6
Height of incisor	5.8	6.3	6.1	6.7	–
Depth of incisor	2.1	2.0	2.1	2.1	2.2
Breadth of occipital condyles	9.3	9.0	8.8	9.2	8.8

Figure 3. Fresh-dead wet specimen of Tweedy's Crab-eating Rat, *Ichthyomys tweedii* (MNCR-M2106), collected in Quebrada Wilson, Las Cruces Biological Station, San Vito, Puntarenas Province, Costa Rica, on July 2008.

identified as *I. tweedii* by having an unicolored tail, a hindfoot shorter than 38 mm, a maxillary molars crown length longer than 4 mm, a bilobed mandibular third molar, and a condyle-incisive length longer than 33 mm (Table 1; Figs 3, 4). For specific comparisons with the other *Ichthyomys* species, see Voss (2008, 2015) and Fernández de Córdova et al. (2019).

Discussion

As mentioned above, this new report represents an extension of the known geographic distribution of *I. tweedii*, approximately 300 km from the closest report in Panama and more than 1400 km from its type locality in Ecuador (Fig. 1). With *Rheomys raptor* Goldman, 1912 and *R. underwoodi* Thomas, 1906, it represents the third ichthyomyine species and second genus reported for Costa Rica, increasing the country's number of rodent species to 50 (Villalobos-Chaves et al. 2016).

Despite active and long-term research focusing on characterizing the mammalian diversity in Costa Rica (Rodríguez-Herrera et al. 2005, 2014), new species are still being discovered (Ramírez-Fernández et al. 2015; González-Maya et al. 2017; Villalobos-Chaves et al. 2018). This is evidence of the knowledge gaps that still exist in relation to Costa Rican mammal diversity and for the need to support more research. Elusive, nocturnal, and highly specialized habits are often characteristics observed in newly recorded species. In the case of ichthyomyines, Voss (2015) previously noted that standard trapping methods are usually ineffective for capturing these rodents, and as a consequence, their abundance and distribution can be easily underestimated by general surveys or inventories.

Many researchers have demonstrated that combining different kinds of trapping methods or adding some variations to the classic techniques (e.g., Risch and Brady 1996; Santos-Filho et al. 2015) can enhance trapping efficiency on small mammal communities and increase the reliability of the recorded diversity. Given that *Ichthyomys tweedii* is listed as Data Deficient by the IUCN and as Critically Endangered by Panama environmental authorities (Boada et al. 2019), a detailed survey designed with the appropriate methods to capture this species in very specific localities could generate valuable ecological information with important implications on its local and global current conservation status.

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Authors' Contributions

JDRF and FJDA made the cranial and dental measurements. MFV prepared the specimen, made the external body measurements, and took the pictures. JDRF

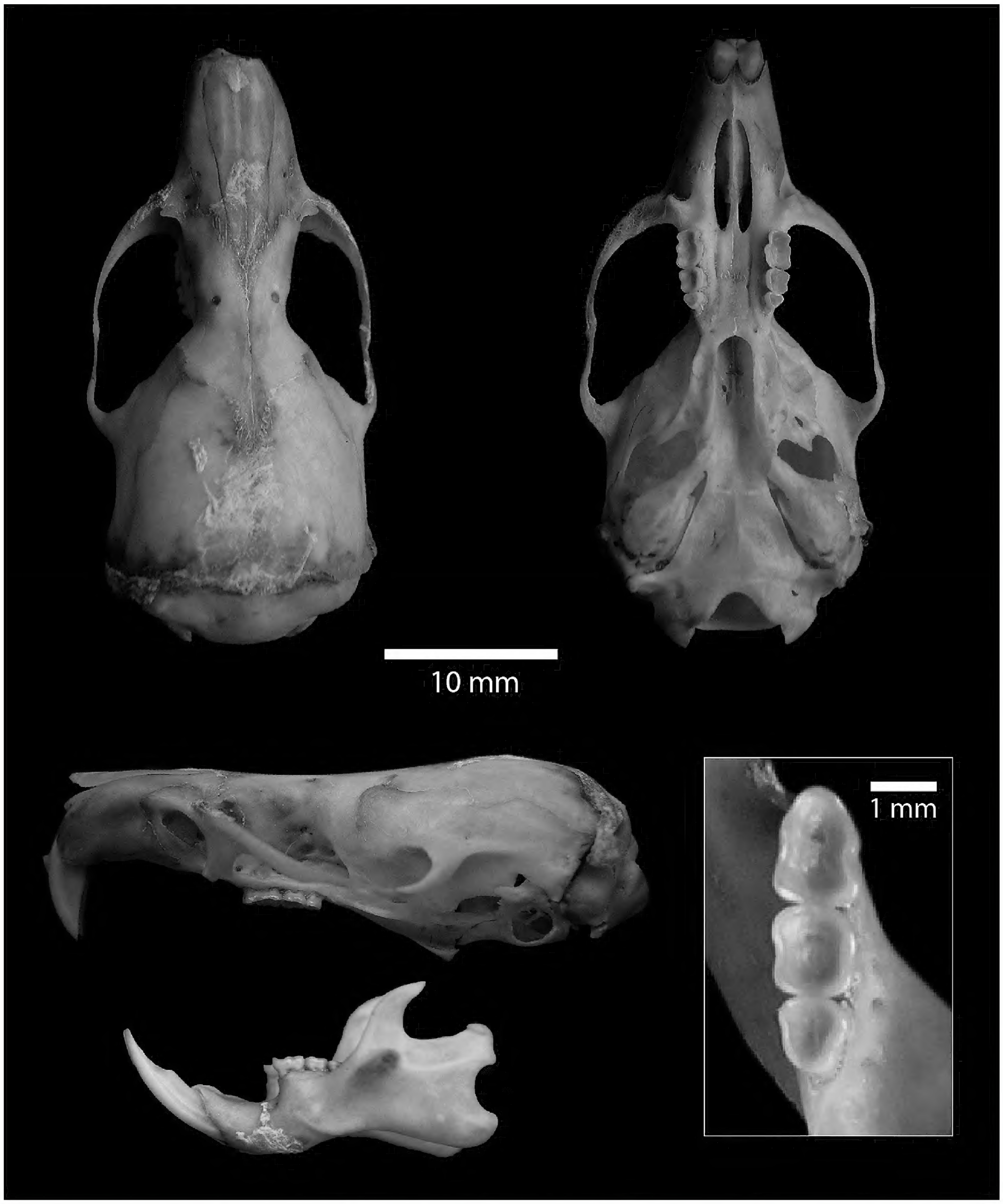

Figure 4. Dorsal, ventral, and lateral view of the skull and mandible of Tweedy's Crab-eating Rat, *Ichthyomys tweedii* (MNCR-M2106), collected in Quebrada Wilson, Las Cruces Biological Station, San Vito, Puntarenas Province, Costa Rica. Inset shows detail of the right mandibular molar tooth row.

reviewed and identified the specimen. All the authors were involved in the writing, edition, and improvement of the manuscript final draft.

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